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CARBONATION IN CONCRETE AND EFFECT ON STEEL CORROSION

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16. Abstract

An investigation was conducted to establish a prognosis for carbonation-induced corrosion of steel in concrete in present and future Florida highway structures. A survey of 18 existing bridges built between 1939 and 1981 (ages 14 years < t < 56 years) revealed carbonation depths $x_c \lesssim 50$ mm with a median of $\approx$ 10 mm. Carbonation coefficients $K_c = x_c\, t^{-1/2}$ ranged from 0 to 14 mm/y$^{1/2}$, with a median value of 1.4 mm/y$^{1/2}$. The highest values of K_c were observed on the decks of inland bridges. The projected time to corrosion initiation for the combination worst 10-percentile K_c values and lowest 10-percentile reinforcement cover was $\lesssim$66 years. Only a very small fraction of the present inventory of Florida D.O.T. bridges is expected to exhibit carbonation-induced corrosion over a 75-year service life. Laboratory tests were conducted to determine the influence of mix design on the carbonation resistance of concretes to be used in new Florida D.O.T. construction. The results indicate that the time for initiation of carbonation-induced corrosion may be shortened by $\approx$60% when the fly ash cement replacement is increased from 20% to 50%. The initiation time may be shortened by $\approx$35 when cement replacement is increased from 20% fly ash to 20% fly ash plus 8% silica fume.

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